

REMARKS

Examination and allowance of pending Claims 1-23 are respectfully requested.

The Examiner rejected Claims 1-23 under 35 U.S.C. § 102(b) as being anticipated by Shaw et al (U.S. Patent 5,719,073), hereinafter Shaw.

Shaw does not describe nor suggest ... a moveable micromirror comprising a supporting structure...a *flexible* post extending from the supporting structure...a table extending radially from the end of the post along a plane generally *perpendicular* to the post, the table having a reflective surface facing away from the supporting structure, wherein the post is so constructed so as to be sufficiently flexible to allow the reflective surface to be selectively moveable and positionable, with at least two degrees of freedom, when urged by a suitable actuating force.... as described in Applicants' Claim 1. (emphasis added).

Shaw describes a single mask, low temperature reactive ion etching process for fabricating high aspect ratio, released single crystal microelectromechanical structures independently of crystal orientation. However, Shaw does not describe or suggest a *flexible* post extending from the supporting structure...a table extending radially from the end of the post along a plane generally *perpendicular* to the post ... as recited in Applicants' Claim 1.

Applicants fails to see where the recited elements are specifically described in the Shaw reference. Applicant contends that nowhere in Shaw is there a description or suggestion of this novel element of ... "a flexible post extending from the supporting structure...a table extending radially from the end of the post *along a plane generally perpendicular* to the post". Applicant notes that the Examiner did not identify where this specific element is taught in the alleged anticipating reference. While the Examiner points to Shaw's **FIG. 2**, reference numerals 50, 52, and 62 as teaching Applicants' elements, these numerals refer to elements that are not equivalent to Applicants' elements in function or physical layout or design.

Shaw recites at col. 13, lines 35-38, "a wafer 50 of single crystal silicon is patterned to produce a single released beam 52 located in a trench 54, the beam 52 being similar to beam 36 of FIG. 1J".... and at col. 13, lines 43-52 , "Also defined by the trench 54 are additional fixed structures such as contact pads 60, 62 and 64 and their corresponding interconnects. Pad 62 is connected to the released beam 52 by way of interconnect 66, as illustrated in FIG. 4, which is a crosssection taken along line 4--4 of FIG. 2. The interconnect is illustrated as being wider than the released beam 52 of FIG. 3, and is not released from the substrate 50 so that it is stationary and provides a support wall at region 68 (FIG. 2) for mounting a fixed end of the cantilevered released beam 52."

Further Shaw clearly recites at col. 8, lines 13-16, "These figures illustrate the fabrication of a released, cantilevered beam which is free to move left or right in a generally horizontal path (as viewed in the Figures)..."

Accordingly, Shaw's device describes a pad 62 suspended by a beam 52 that is parallel to the substrate 50. Further, the pad face also lies substantially parallel to the plane of the substrate as shown in **FIG. 2** which signifies that the Shaw device, unlike Applicants' invention, has limited, if any, degrees for deflectional (tilt) operation of the pad. Hence, contrary to Applicants' invention, Shaw's device translates the pad only in its plane.

No mention of a table ... along a plane ... perpendicular to the post or allowing the reflective surface to be selectively moveable and positionable, with at least two degrees of freedom... is made within the Shaw description. Further, Applicant argues that the Shaw description does not disclose or suggest any notion of creating a moveable micromirror and likely teaches away from this notion since Shaw's interconnects connecting the pad to the beam are not intended to move (Shaw col. 7, lines 12-13).

Applicants contend that one of ordinary skill in the art would find there to be a marked difference in the elements and implementation of Applicants' claimed elements with that of the referenced prior art. Furthermore, Applicant

feels that the elements in Applicants' Claim 1 goes to the very essence of Applicants' invention and as such is not merely a minor aspect of the claimed invention warranting an inherency or common knowledge rationale of the prior art and hence allowing for the gap in the reference. Applicants conclude that the missing elements would not necessarily result from the prior art reference.

Accordingly, Applicants argue that each and every feature of the claim as arranged in the claim is not taught by the cited prior art reference and that hence a *prima facie* case of anticipation has not been made.

For that reason, Applicants contend that the rejection is improper and Applicants' Claim 1 is patentably distinct over the Shaw reference under 35 U.S.C. § 102(b). Applicants' Claims 2-13, which depend directly or indirectly from base Claim 1, are also patentably distinct over the Shaw reference under 35 U.S.C. § 102(b) for reasons discussed above in conjunction with Claim 1.

The Examiner states that independent base Claim 14 is also anticipated by Shaw. Applicants maintain similar arguments discussed above in conjunction with Claim 1 in that Shaw does not describe or suggest ... *a table fixed along a plane generally perpendicular to and supported by the post* and having a reflective surface facing away from the surface of the substrate ...an actuator positioned on the surface of the substrate adjacent the second surface of the table and structured so as to be able to selectively position the table by applying

an actuating force to the table wherein the post is sufficiently flexible to allow the reflective surface to be selectively moveable and positionable by the actuator... as recited in Applicants' newly amended base Claim 14 (emphasis added).

Hence, it would not have been obvious to one of ordinary skill in the art at the time the invention was made to have, as Applicants recite in Claim 14 ... "a table fixed along a plane generally perpendicular to and supported by the post ... wherein the post is sufficiently flexible to allow the reflective surface to be selectively moveable and positionable by the actuator." Additionally, applying the rationale above, Applicants contend that Claims 15 and 16, which directly depend from Claim 14, are also not anticipated by the Shaw reference.

Accordingly, the rejection under 35 U.S.C. § 102(b) with respect to Applicants' Claims 14-16 is improper and should be removed.

The Examiner further rejected Applicants' method Claims 17-23 under 35 U.S.C. § 102(b) as being anticipated by Shaw.

Shaw does not describe or suggest ... deep etching a silicon substrate so as to form posts surrounded by trenches ... etching back the surface of the substrate around the posts so as to allow the posts to protrude beyond the surface of the substrate ... and affixing a mirror to the top of a plurality of the

posts... along a plane generally perpendicular to the posts as recited in

Applicants' newly amended Claim 17.

There is no description in the cited section of Shaw of affixing a mirror to the top of a plurality of posts along a plane generally perpendicular to the posts.

Shaw col. 4, lines 60-67 generally recites that a membrane can be added to released structures and polished for use as moveable mirrors. Tungsten or a dielectric such as nitride or oxide can be used as a Shaw membrane. (Shaw, col. 21, lines 55-58). Shaw does not describe how this membrane is added or deposited. Nowhere is this Shaw membrane described or suggested as being "affixed" to the top of a plurality of posts and furthermore, nowhere is it described or suggested that it be along a plane generally perpendicular to the posts.

Accordingly, and for reasons discussed above in conjunction with Claims 1 and 14, Applicants' Claim 17 is not anticipated by Shaw.

Nowhere described or suggested in Shaw are the recited steps found in dependent Claims 18-23. These claims recite steps of a separate process using a separate substrate. For instance recited steps in Claim 18 ... bonding a wafer to the tops of the plurality of the posts...depositing ... reflective layers on ... the wafer opposite the post... deep etching the wafer to separate the wafer into individual mirrors... are not described or motivated by Shaw.

The device described by Shaw is manufactured from a single substrate, a process that would limit the functionality desired by Applicants. Applicants' manufacturing process requires the affixing of a mirror to the post in a separate procedure from a separate substrate. Applicants' table and post are made from two separate single crystal silicon substrates. The table substrate is bonded to the post substrate after the posts are formed. Applicants' specification relating to FIGs. 11-17 describes the conditioning of the first substrate used to make the posts and other conductive structures. Applicants' FIG. 18 depicts a second substrate (200 um thinned Si) that is notched to register with the posts of the first substrate. This substrate then is bonded to the first substrate and further etching of the composite structure defines the tables on the posts. The description with respect to FIG. 22 on page 8 of Applicants' specification recites the two-substrate nature of Applicants' device.

Accordingly, and for reasons discussed above in concert with Applicants' base Claim 17, Applicants' Claims 18-23 are also patentably distinct over the Shaw reference under 35 U.S.C. § 102(b).

CONCLUSION

Based upon the above amendments, remarks and papers of record, Applicants believe the pending claims of the above-captioned application are in allowable form and patentably distinct over the prior art of record. Applicants respectfully request reconsideration of the pending claims and a prompt Notice of Allowance thereon.

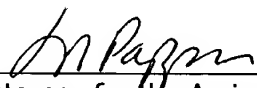
Applicants believe that a **two (2)-month** extension of time is necessary to make this Response timely. Should Applicants be in error, Applicants respectfully request that the Office grant such time extension pursuant to 37 C.F.R. 1.136(a) as necessary to make this Reply timely, and hereby authorizes the Office to charge any necessary fee or surcharge with respect to said time extension to the deposit account of the undersigned firm of attorneys, Deposit Account 03-3325.

Please direct any questions or comments to Joanne Pappas at (781) 280-9031.

Respectfully submitted,

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Date: **May 7, 2003**



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VERSIONS OF MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

Paragraphs [0027], [0029], [0030], and [0031] on page 4 have been amended as follows:

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[0028] Figure 21 is a cross-sectional view of the material of Figure 17 or Figure 20 with the thin material of Figure 18 aligned thereto and positioned thereon such that the top of the post 26 is positioned and fixed within the slot 56[.];--

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[0029] Figure 23 is a cross-sectional view of the material of Figure 22 after removal of the photoresist 52 and after wirebonding[.];

[0030] Figure 24 is a cross-sectional view of another embodiment of the mirror of the present invention[.];

[0031] Figure 25 is a cross-sectional view of yet another embodiment of the mirror of the present invention[.]; --

IN THE CLAIMS:

1. (Unchanged) A moveable micromirror comprising:
 - a supporting structure;
 - a flexible post extending from the supporting structure; and
 - a table extending radially from the end of the post along a plane generally perpendicular to the post, the table having a reflective surface facing away from the supporting structure,wherein the post is so constructed so as to be sufficiently flexible to allow the reflective surface to be selectively moveable and positionable, with at least two degrees of freedom, when urged by a suitable actuating force.

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2. (Unchanged) The moveable micromirror of claim 1 wherein the flexible post extends from the supporting structure from within a trench in the supporting structure such that more than one half of the length of the post is within the trench.
3. (Unchanged) The movable micromirror of claim 2 wherein at least three-quarters of the length of the post is within the trench.
4. (Unchanged) The moveable micromirror of claim 1 wherein the supporting structure and the post are formed of a single crystal of silicon.
5. (Unchanged) The moveable micromirror of claim 1 further comprising conductive pads positioned on a surface of the supporting structure facing the table, and wherein the table includes a conductive material.
6. (Unchanged) The moveable micromirror of claim 5 wherein the average distance from the surfaces of the conductive pads to the surface of the table facing the conductive pads is less than the length of the post.
7. (Unchanged) The moveable micromirror of claim 6 wherein the average distance from the surfaces of the conductive pads to the surface of the table facing the conductive pads is less than one-half the length of the post.

8. (Unchanged) The moveable micromirror of claim 7 wherein the average distance from the surfaces of the conductive pads to the surface of the table facing the conductive pads is less than one-third the length of the post.
9. (Unchanged) The moveable micromirror of claim 1 further comprising an electrostatic actuator structured and arranged so as to be able to selectively position the reflective surface.
10. (Unchanged) The moveable micromirror of claim 1 further comprising an electromagnetic actuator structured and arranged so as to be able to selectively position the reflective surface.
11. (Unchanged) The moveable micromirror of claim 1 further comprising a piezoelectric actuator structured and arranged so as to be able to selectively position the reflective surface.
12. (Unchanged) The moveable micromirror of claim 1 further comprising a thermal actuator structured and arranged so as to be able to selectively position the reflective surface.
13. (Unchanged) An array of moveable micromirrors comprising two or more micromirrors as recited in claim 1.
14. (Once Amended) A moveable micromirror for selectively directing optical beams, the micromirror comprising:
 - a substrate formed of a first single crystal of silicon;

a post extending from within a moat in a surface of the substrate, the post being formed of the single crystal of silicon;

a table fixed along a plane generally perpendicular to and supported by the post and having a reflective surface facing away from the surface of the substrate and a second surface facing the surface of the substrate, the distance from the surface of the substrate to the second surface of the table being less than the length of the post; and

an actuator positioned on the surface of the substrate adjacent the second surface of the table and structured so as to be able to selectively position the table by applying an actuating force to the table

wherein the post is sufficiently flexible to allow the reflective surface to be selectively moveable and positionable by the actuator.

15. (Unchanged) The moveable mirror of claim 14 wherein the actuator is an electrostatic actuator.

16. (Once Amended) An array of micromirrors comprising at least two of the moveable [mirror] mirrors recited in claim 14.

17. (Once Amended) A method of making an array of moveable micromirrors, the method including:

deep etching a silicon substrate so as to form posts surrounded by trenches;

etching back the surface of the substrate around the posts so as to allow the posts to protrude beyond the surface of the substrate; and

affixing a mirror to the top of a plurality of the posts along a plane generally perpendicular to the posts.

18. (Unchanged) The method of claim 17 wherein the step of affixing a mirror to the top of a plurality of the posts includes:

bonding a wafer to the tops of the plurality of the posts;

depositing one or more reflective layers on the surface of the wafer opposite the posts; and

deep-etching the wafer to separate the wafer into individual mirrors affixed to the top of each post of the plurality of the posts.

19. (Unchanged) The method of claim 18 wherein the step of affixing a mirror to the top of a plurality of the posts further includes, before the step of bonding a wafer to the tops of the plurality of the posts, the step of forming a removable layer on the substrate, and wherein the step of bonding a wafer to the tops of the plurality of the posts includes positioning the wafer in contact with the tops of the posts and in contact with the removeable layer.

20. (Unchanged) The method of claim 19 wherein the removeable layer is a layer of photoresist.

21. (Unchanged) The method of claim 19 wherein the step of bonding a wafer to the tops of the plurality of the posts includes etching notches in the wafer and aligning the notches with the plurality of the posts such that the plurality of the

posts are positioned within the notches and are bonded to the wafer in the notches.

22. (Unchanged) The method of claim 18 wherein the step of deep etching the wafer to separate the wafer into individual mirrors includes deep reactive ion etching.

23. (Unchanged) The method of claim 17 wherein the step of deep etching the silicon substrate includes deep reactive ion etching.